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CENTER FOR DISEASE CONTROL

NUTRITION SURVEILLANCE

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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

PUBLIC HEALTH SERVICE

PREFACE

This report summarizes information, including selected indices of nutrition status, received from five participating States which comprise the initial group of contributors to a developing program of nutrition surveillance in the United States. We will consider adding other indices as their utility and availability become evident. To the extent possible, tabulations in subsequent issues will be presented in the same format unless experience indicates a change is appropriate.

The data presented in these tabulations come from a variety of sources including health department clinics, Headstart programs, and other health care situations. Because of the lack of uniformity of data sources, as well as methodology, direct comparisons among States should be made with caution.

Contributions to the Nutrition Surveillance Report are welcome. Please submit to:

Center for Disease Control
Attention: Preventable Disease and
Nutrition Activity
Atlanta, Georgia 30333

Center for Disease Control . . . . .David J. Sencer, M. D.
Director

Nutrition Indices by State

Data presented in Tables 1-6 represent children examined during the first and second quarters of 1974. Only persons reported to the Center for Disease Control prior to October 25, 1974, are included. The criteria for selection of persons with low or high values appear on page 6. Data presented in these tables should be considered preliminary.

The data supplied by the States indicate that iron deficiency anemia continues to be a major nutritional problem as measured by hemoglobin and hematocrit levels (Tables 1 and 2). Hemoglobin and hematocrit levels identify somewhat different numbers of children in the same population. This shows that these two indicators are not directly interchangeable. The Center for Disease Control is undertaking an analysis of hemoglobin and hematocrit data to determine the ability of hematocrits to accurately identify children with specified low hemoglobin levels. These data will be presented in a subsequent nutrition surveillance report.

Growth data are being used in this surveillance bulletin as one index of a child's nutritional status. Many children are being found in the participating States who fall below the 5th percentile of growth and development as measured by height for age. This index of growth retardation reflects possible long-term nutritional deprivation. Although it is well established that growth and development are affected by poor nutrition, we do not mean to imply that nutritional intake is the only determinant of a child's height. The data on weight for height show considerably more children in the high (potentially obese) than in the low (underweight) percentiles. In addition there are more children with low height for age than with low weight for age. These data indicate that the population under surveillance is relatively overweight. This is common knowledge and supports data from several national studies demonstrating a high prevalence of obesity even in the lower socio-economic U.S. population.

A comparison of Tables 1 and 2, which show percentage for the first and second quarters, demonstrates little change except for a drop in the percent with low hemoglobin. A closer inspection reveals that only Kentucky showed a decrease. This, combined with the increase in the number reported from Washington which has the same low percentage in both quarters, resulted in the overall drop from 9.2 to 5.4 percent with low hemoglobins.

The analysis of the data by sex and ethnic group (Tables 3 and 4) shows little important differences in the various subgroups except for more short males than females. Recent studies of selected populations have shown that black children are somewhat taller than white children of the same age, sex, and socio-economic status. The percentage of black children with low height

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for age may therefore represent a minimum estimate of the true prevalence of poor growth and development, since the white and black children have been compared to the same reference standards in these surveillance data.

A high prevalence of American Indian children who are short for age is also demonstrated by the surveillance data. This is different from other published data which indicate that American Indians are not markedly different from U.S. standard reference populations. The American Indians included in this surveillance report also had a higher percentage of children with low hemoglobins when compared with other ethnic groups. The majority of American Indians under the current surveillance system are in urban populations and may represent a particular problem of moderately severe socioeconomic and nutritional deprivation. One other interesting observation is the relatively high percentage of Spanish Americans and American Indians whose weight for height was above the 95th percentile. This is also an indication of an obesity problem among these groups.

The nutritional indices analyzed by age emphasize the problems in interpretation of hematocrits and hemoglobins. For example, among males during the first quarter the percentage with low hemoglobins decreases from the 2 to 5 age group to the 6 to 9 age group. On the other hand, the percentage with low hematocrits increases in the 6 to 9 age group compared with the 2 to 5 age group. There is an increase in the prevalence of both low hemoglobin and low hematocrit with age in the females.

The relatively high percentage of overweight as expressed by weight for height in the very young age groups and the teenage females are cause for considerable concern. The national problem of obesity can be seen to have its roots in some of the earliest phases of development of nutritional habits. Obesity, and its sequelae such as coronary artery disease, hypertension, etc., can be seen to be a pediatric as well as an adult problem.

The data from Louisiana are not included in these tabulations for technical reasons but will be presented in subsequent reports. A special analysis of the Louisiana data is included under the Special Reports section.

Table 1

Nutrition Indices by State, January-March 1974
Persons Less than 18 Years of Age

State	Hemoglobin		Hematocrit		Height For Age		Weight For Age		Weight For Height		
	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	% High
Arizona	2,450	14.5	1,767	14.7	3,475	15.3	3,474	8.6	3,296	5.1	16.0
Kentucky	5,036	9.2	3,738	19.6	6,624	13.4	6,492	6.6	6,388	6.5	12.8
Tennessee	192	10.4	1,149	16.9	1,864	14.0	1,871	7.3	1,848	4.7	12.8
Washington	1,864	1.9	2,583	11.3	3,084	12.8	3,072	5.9	3,038	3.6	12.2
Total*	9,542	9.2	9,237	16.0	15,047	13.8	14,909	7.0	14,570	5.4	13.4

*Includes unknown sex.

Table 2

Nutrition Indices by State, April-June 1974
Persons Less than 18 Years of Age

State	Hemoglobin		Hematocrit		Height For Age		Weight For Age		Weight For Height		
	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	% High
Arizona	1,608	15.8	1,046	14.5	2,198	14.1	2,199	7.8	2,105	4.9	14.6
Kentucky	5,560	6.9	3,902	20.7	6,631	15.3	6,558	7.3	6,373	5.9	14.4
Tennessee	291	10.7	2,455	18.1	3,582	10.4	3,588	6.4	3,168	4.5	11.5
Washington	7,453	1.9	6,205	12.4	7,504	12.7	7,504	5.5	7,389	3.4	13.7
Total*	14,912	5.4	13,608	16.0	19,915	13.3	19,849	6.5	19,035	4.6	13.7

*Includes unknown sex.

Table 3

Nutrition Indices by Sex and Ethnic Group, January-March 1974
Persons Less than 18 Years of Age

Sex and Ethnic Group	Hemoglobin No. Exam.	Hemoglobin % Low	Hematocrit No. Exam.	Hematocrit % Low	Height For Age No. Exam.	Height For Age % Low	Weight For Age No. Exam.	Weight For Age % Low	Weight For Height No. Exam.	Weight For Height % Low	Weight For Height % High
Male											
Black	898	11.8	708	21.8	1,338	16.2	1,330	7.8	1,304	4.8	13.4
White	2,833	7.7	2,869	16.4	4,637	13.6	4,572	7.5	4,521	5.9	11.8
Sp.American	335	5.1	422	8.3	501	14.2	500	4.4	476	4.4	23.1
Am. Indian	615	15.3	456	18.0	835	17.0	837	8.7	799	4.6	16.1
Oriental	11	9.1	9	0.0	13	7.7	13	0.0	13	0.0	0.0
Other	22	0.0	21	23.8	28	21.4	28	17.9	28	14.3	10.7
Unknown	117	6.8	168	8.3	215	12.1	214	4.2	202	6.4	16.3
Total	4,831	9.2	4,653	16.3	7,567	14.5	7,494	7.4	7,343	5.5	13.4
Female											
Black	940	12.0	728	21.0	1,447	13.7	1,446	5.9	1,416	5.0	13.5
White	2,748	7.5	2,837	15.1	4,484	12.3	4,423	6.5	4,327	5.9	12.2
Sp. American	286	3.8	388	9.0	468	12.8	468	4.7	449	3.1	21.8
Am. Indian	621	15.3	435	19.5	855	16.7	853	8.9	812	3.9	15.3
Oriental	7	0.0	7	14.3	11	9.1	11	9.1	11	0.0	0.0
Other	14	7.1	16	6.3	22	13.6	22	0.0	22	0.0	9.1
Unknown	93	5.4	146	9.6	193	13.5	192	9.9	190	4.2	11.6
Total	4,709	9.1	4,557	15.7	7,480	13.1	7,415	6.6	7,227	5.2	13.3

Table 4

Nutrition Indices by Sex and Ethnic Group, April-June 1974
Persons Less than 18 Years of Age

Sex and Ethnic Group	Hemoglobin No. Exam.	Hemoglobin % Low	Hematocrit No. Exam.	Hematocrit % Low	Height For Age No. Exam.	Height For Age % Low	Weight For Age No. Exam.	Weight For Age % Low	Weight For Height No. Exam.	Weight For Height % Low	Weight For Height % High
Male											
Black	1,216	6.8	1,197	20.7	1,838	14.0	1,825	8.3	1,776	5.1	11.5
White	4,581	4.9	4,208	16.4	6,239	13.5	6,216	6.4	5,937	4.9	13.1
Sp. American	485	2.5	451	11.3	522	13.8	522	5.2	513	4.9	19.1
Am. Indian	883	7.7	668	13.0	1,016	13.6	1,016	5.1	987	3.4	20.1
Oriental	19	0.0	12	16.7	19	21.1	19	31.6	19	10.5	5.3
Other	80	1.3	69	11.6	87	21.8	86	12.8	85	4.7	10.6
Unknown	339	2.4	302	9.6	365	15.9	367	10.4	348	4.9	13.5
Total	7,603	5.2	6,907	16.2	10,086	13.8	10,051	6.8	9,665	4.8	13.8
Female											
Black	1,254	6.6	1,185	20.3	1,872	12.2	1,867	7.2	1,810	4.1	12.6
White	4,239	5.5	4,008	15.8	5,965	12.8	5,937	6.2	5,638	4.9	12.9
Sp. American	445	1.3	436	16.3	484	14.5	484	4.5	470	2.6	18.3
Am. Indian	986	8.2	719	11.7	1,097	13.9	1,098	5.3	1,064	2.9	18.1
Oriental	19	0.0	14	0.0	19	21.1	19	5.3	19	0.0	10.5
Other	65	3.1	58	8.6	66	10.6	67	6.0	64	9.4	9.4
Unknown	297	3.0	272	8.1	326	10.7	326	6.1	305	3.0	10.2
Total	7,305	5.7	6,692	15.8	9,829	12.8	9,798	6.2	9,370	4.3	13.6

Table 5

Nutrition Indices by Sex and Age, January-March 1974
Persons Less than 18 Years of Age

	Hemoglobin		Hematocrit		Height For Age		Weight For Age		Weight For Height		
	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	% High
Male											
<1	1,083	7.0	1,246	13.3	2,186	18.6	2,153	9.6	2,075	7.4	15.3
1	939	8.8	964	9.4	1,389	16.2	1,369	7.2	1,348	5.6	18.6
2-5	1,846	12.2	1,848	21.0	2,715	12.8	2,696	5.7	2,656	3.7	12.4
6-9	369	11.1	274	28.8	513	8.6	511	5.3	508	6.1	7.1
10-12	252	6.0	157	17.8	336	8.9	337	7.7	336	7.4	5.4
13-17	342	1.2	164	4.9	428	9.8	428	10.3	420	4.8	7.9
Total	4,831	9.2	4,653	16.3	7,567	14.5	7,494	7.4	7,343	5.5	13.4
Female											
<1	1,119	5.6	1,237	13.5	2,149	14.3	2,122	8.0	2,047	7.4	15.6
1	874	8.0	894	11.5	1,334	17.9	1,326	6.7	1,298	4.1	19.6
2-5	1,743	11.6	1,773	18.7	2,662	12.8	2,636	5.6	2,602	3.1	10.8
6-9	372	14.2	262	27.9	506	7.3	507	5.1	500	8.2	7.0
10-12	211	10.4	155	15.5	309	7.8	310	10.6	303	10.9	4.6
13-17	390	4.9	236	7.2	520	6.5	514	5.1	477	4.2	12.4
Total	4,709	9.1	4,557	15.7	7,480	13.1	7,415	6.6	7,227	5.2	13.3

Table 6

Nutrition Indices by Sex and Age, April-June 1974
Persons Less than 18 Years of Age

Sex and Age Group	Hemoglobin		Hematocrit		Height For Age		Weight For Age		Weight For Height		
	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	% High
Male											
<1	2,205	3.2	2,164	13.3	3,220	16.2	3,204	8.6	3,061	5.8	14.2
1	1,598	4.9	1,443	10.3	2,029	15.3	2,023	6.4	1,957	5.5	19.8
2-5	3,058	6.2	2,708	20.2	3,754	12.3	3,742	5.4	3,605	3.6	12.2
6-9	361	11.6	318	31.8	519	10.8	519	6.9	491	4.1	6.9
10-12	184	6.0	148	18.9	282	6.0	280	6.1	273	7.0	5.9
13-17	197	2.0	126	3.2	282	9.6	283	9.5	278	2.9	7.2
Total	7,603	5.2	6,907	16.2	10,086	13.8	10.051	6.8	9,665	4.8	13.8
Female											
<1	2,053	3.4	2,056	12.4	3,079	13.8	3,071	7.8	2,908	6.5	14.4
1	1,471	5.2	1,322	10.1	1,874	16.7	1,862	6.2	1,786	4.5	20.2
2-5	3,022	6.7	2,678	19.1	3,699	11.4	3,688	4.8	3,580	2.5	11.1
6-9	354	13.6	319	34.5	537	7.3	536	3.0	497	4.6	7.8
10-12	166	4.2	150	20.0	273	12.1	274	12.8	257	5.4	6.6
13-17	239	4.2	167	9.0	367	7.9	367	6.5	342	3.2	11.4
Total	7,305	5.7	6,692	15.8	9,829	12.8	9,798	6.2	9,370	4.3	13.6

Criteria for identifying individuals with low or high values.

1. Low Hemoglobin and Low Hematocrit: Hemoglobin or hematocrit below the level specified in the following table for appropriate age and sex.

Age	Hgb.	Hct.
6-23 months	10 grams	31%
2-5 years	11 grams	34%
6-14 years	12 grams	37%
15 or more years (females)	12 grams	37%
15 or more years (males)	13 grams	40%

2. Low Height for Age: Height for age less than the 5th percentile of a person at the same sex and age in the reference population.

3. Low Weight for Age: Weight for age less than the 5th percentile of a person of the same sex and age in the reference population.

4. Low Weight for Height: Weight for height less than the 5th percentile of a person at the same sex and height in the reference population.

5. High Weight for Height: Weight for height greater than the 95th percentile of a person of the same sex and height in the reference population.

Reference Population: Smoothed distributions of percentiles of the following populations:

Age	Reference Population Data
Birth - 24 months	Fels Research Institute Growth Study
25 - 59 months	Preschool Nutrition Survey
60 - 143 months	National Health Examination Survey, Cycle II
144 - 215 months	National Health Examination Survey, Cycle III

Note: Growth percentiles represent heights and weights which have been standardized for sex and age, and sex and height (for weight for height). Therefore height and weight comparisons may be made between groups of individuals using percentiles without being concerned about the age and sex distributions of groups being compared. However, comparison of height and weight among groups with persons of diverse ethnic origins should be made with care because of genetic differences in growth potential. Differences observed between groups may be due to differences in the ethnic makeup of the groups rather than differences in nutritional status.

SPECIAL REPORTS

Nutrition Surveillance in the United States

1. Introduction and Background

The literature contains accounts of many nutritional status studies conducted throughout the United States; however, few have been performed on a regional or national basis. Prior to the late 1960's, these studies consisted primarily of dietary investigations such as the USDA Household Food Consumption Survey conducted in 1955 and again in 1965. In 1968, a largely subjective report entitled Hunger U.S.A. was published by the Citizens Board of Inquiry into Hunger and Malnutrition in the United States.

Between 1968 and 1972, three major nutrition surveys were conducted. One of these, the Ten-State Nutrition Survey (1), was the largest and most comprehensive ever conducted in the United States and focused on the lower income populations in 10 selected States. The Preschool Nutrition Survey (2), comprised a random sample of the U.S. preschool-age population, and more recently, the first Health and Nutrition Examination Survey (3) (HANES), was conducted from 1971-1973 on a random sample of the total U.S. population.

These major surveys tend to support one another. While the kinds and degrees of malnutrition vary from place to place and are present among all ages, ethnic groups, and economic levels, nutritional problems appear to be most prevalent in young, minority group individuals of low socioeconomic status (4). The surveys also documented the major nutritional problems in the United States -- growth deficit, obesity, anemia, and dental caries (5). In order to increase the knowledge of nutritional status in this country, the Center for Disease Control, after consultation with various State and national nutritionists, has undertaken the surveillance of growth, obesity, and anemia, and periodically plans to share this information through the dissemination of a surveillance report.

2. Definition of Terms

The tools of nutritional assessment, both of individuals and population groups, are:

a) biochemical measurements of nutrients in body fluids and tissues;

b) clinical examination, including assessment of growth by utilizing body measurements; and

c) collection of dietary information.

The major objective data used for the determination of nutritional status are anthropometric and biochemical. Dietary intake data are most useful in pointing out avenues for intervention. They should be confirmed by biochemical values, body measurements, or the presence or absence of clinical signs.

Nutrition surveys traditionally have involved the examination of a population group at a specific point in time and are thus "cross-sectional" in nature. They provide information about the prevalence of a condition in a population at a given point in time. They do not provide insight into the number of individuals who may be expected to develop a condition over time.

A nutrition survey requires rigorous sampling procedures so that accurate estimates of the magnitude of problems identified within the selected population can be made. If sampling is unrepresentative or if an insufficient proportion of the population sample participates, conclusions and generalizations will be severely restricted. Usually, the sampling frame is quite broad -- a county, State, or larger region -- so that the resulting data are not particularly useful for program planning purposes at the local level. Although problems are identified, neither specific locations nor the relative magnitude of problems in different locations are identified. Unfortunately, this is precisely the kind of information which is required for effective and rational programming at the local level.

Nutrition surveys, if conducted in the same population at two or more points in time utilizing similar methodology and sampling methods, can provide useful information regarding changes that occur over time in these groups. This aspect of HANES has prompted the use of the words "monitoring" or "surveillance" in describing this activity (3).

Surveillance, as contrasted to a survey, implies continuity — a frequent and continuous "watching over." Repeated surveys do not accomplish this, particularly if the period of time between population sampling is protracted. Therefore, an activity that monitors individual groups, particularly high-risk groups, on a continuous, uninterrupted basis, is desirable. Surveillance ideally should be carried out within a sampling frame and in a population of known size and characteristics. Practically, if the usefulness of this type of information gathering is to be maximized with a minimum of expense, it is often necessary to deal with "samples of convenience;" i.e. you take what you can get, where you can get it, utilizing the best possible data which describe the sample.

3. Development of a Nutrition Surveillance System

Information relating to nutritional status is being collected in a variety of medical care situations, but is usually not systematically analyzed in terms of the nutritional status of the population groups involved. Examples are the measurement of children and adults in a variety of situations such as well-baby clinics, Headstart programs, school health examinations, family planning clinics and others. Another very common measurement performed in many medical evaluation situations is hemoglobin or hematocrit determination measurements related to anemia and iron deficiency.

Initial efforts have focused on the collection and analysis of these basic data so that some of the data needed at the local level for nutrition programming could be provided. Due to limited resources, initial efforts have concentrated on measurements of height, weight, and hemoglobin or hematocrit. These determinations fortunately relate to the major nutritional deficiency problems that have been identified in the United States -- growth deficit, obesity, and iron deficiency anemia (1,2,

During the past year a number of States have begun to activate Early Periodic Screening, Diagnosis and Treatment (EPSDT) programs which have as part of the required examination the measurement of height, weight, and hemoglobin or hematocrit. In many areas this provides a convenient source of data available at minimal cost. Data have been gathered by State health departments from medical care facilities and programs such as Headstart, EPSDT, Supplemental Feeding Program for Women, Infants, and Children (WIC), and other activities which serve potentially high-risk groups. Expansion to other data sources can be considered as resources permit.

As part of the data collection system, there must be a mechanism for assessing and improving the quality of the data. Two of the most common measurements done in health clinics, height and weight, are often done poorly. This is due partly to inadequate equipment, and partly to inadequate training of the individuals making the measurements. One of the goals of a nutrition surveillance system is to monitor and improve the quality of the measurements, both anthropometric and biochemical, and to evaluate inexpensive and accurate measuring devices.

Uses of Nutrition Surveillance

There are at least six ways in which data from a nutrition surveillance system can be utilized:

a) To define the prevalence of particular nutritional problems in target populations. Although the present system utilizes only height, weight, and hemoglobin or hematocrit, the system may be modified so that other measurements can be utilized.

b) To provide a basis for identifying individuals in need of follow-up and treatment.

c) To provide "before" and "after" information for the evaluation of intervention and preventive programs both for individuals and population groups.

d) To provide data to establish priorities for the allocation of funds and personnel resources.

e) To provide information, geared to the local situation, to enable effective targeting of Federal, State, and local feeding programs.

f) To provide a research base for investigating the relationship between various levels of nutritional status and health consequences.

5. Organization and Future Plans for Nutrition Surveillance

The nutrition surveillance system being developed by CDC has three major components:

a) A data collection system.

b) A mechanism for analyzing the data.

c) A mechanism for returning the results to the originating clinic or activity for their use.

A format has been developed for gathering and submitting data in a standardized, computer-compatible manner from several types of clinics. This format reflects recommendations from other Federal and State health agencies and subcommittees representing the American Academy of Pediatrics and the Food and Nutrition Board, National Academy of Sciences - National Research Council. Working with five States (Arizona, Kentucky, Louisiana, Tennessee, and Washington), basic data collection has been further refined and the fundamental principles contained therein have been widely adopted by other health screening programs, particularly EPSDT and Headstart. This further assures availability of data because of widespread acceptance of the basic methodology.

Analysis of the data from the five States is now being performed at CDC. The ultimate goal is to develop a simple computer system that can be exported to individual States or other geographic entities, which will then be able to handle their own data. Comparisons of height and weight are made with reference population data to characterize the nutritional status of target populations as described in the statement from the Committee on Nutrition Advisory to CDC, Food and Nutrition Board, "Comparison of Body Weights and Lengths or Heights of Groups of Children."

Monthly tabulations are provided both to the clinic and State levels. These consist of listings of individuals requiring nutrition follow-up, together with clinic summaries and the numbers and percentages of children examined who are listed for follow-up because of deficiencies in one or more of the indices. Quarterly and annual summary tabulations are planned to enable geographic comparisons, as well as selected agency and program comparisons. Geographic comparisons of height and weight summaries within and among States with children of diverse ethnic origins should be made with care because of genetic differences in growth potential. Differences observed between geographic areas may be due to differences in the ethnic makeup of the areas rather than differences in nutritional status.

Accurate measurements are critically important if the true picture of the nutritional status of a given population is to be obtained. Tabulations based on data obtained by overmeasuring youngsters for height can convey an impression of excessive leaness when weight for height ratios are considered; the converse is true with consistent undermeasuring for height. These data might be interpreted as showing an excess of overweight or potentially obese children. Mechanisms are being developed to build into the surveillance system the ability to monitor and improve the quality of data being collected. The data will be computer edited for acceptable codes and reasonable values. Those items not meeting these criteria will be identified and corrections will be made in appropriate States in a prescribed manner. A prototype device has also been developed and constructed at CDC which is suitable for measuring the length of infants and the heights of individuals able to stand. This device can be used in both field surveys and in static clinic situations. Recommendations will be forthcoming for standardized methods and equipment for hemoglobin and hematocrit determinations.

The basic data handling system can be modified to permit future incorporation of additional nutritional indices into the basic format on a routine basis. For example, serum cholesterol determinations are being submitted regularly from Arizona. In addition, weight of neonates could be obtained from vital records and submitted routinely. When adjusted for ethnic group, parity, and maternal size, birth weight is a reliable predictor of maternal nutritional status.

Reference Data and Guidelines for Interpretation

In order to make meaningful interpretations of data relating to anemia and physical growth of children, some comparisons must be made with known values derived from an appropriate reference population. Questions which come to mind are: Which reference populations are most appropriate, and what methods of comparison are most useful?

These questions will be discussed briefly below, both for measurements of height and weight and of hemoglobin and hematocrit.

a) Reference Populations

(1) Height (or length) and weight: depending upon circumstances, two alternate criteria have been used in the past for choosing appropriate reference populations for comparison with study populations. One is that the reference population should be reasonably representative of the total population from which the study population is to be drawn. The other is that the reference population be chosen deliberately from an "elite" group, so it will be well-nourished, although unrepresentative. This maximizes both the degree to which the groups' growth potential has been fulfilled, and the probability of detecting significant undernutrition in a study population. In both instances the reference population and the study population should be of the same ethnic mix insofar as possible.

Until recently, reference values on a randomly selected sample, representative of the general population, were not available. The most commonly utilized values, the "Harvard (and Iowa) standards" of Stuart and Meredith (7), were drawn from special studies conducted several decades ago on small numbers of relatively well-nourished children. While they have proven to be most useful as a baseline against which to make relative comparisons of populations, these standards cannot be considered to be normative values for children in the United States today.

Recent studies on large and representative samples of certain age segments of the entire United States population have provided more appropriate reference values for children 2-18 years. The values utilized in the CDC nutritional surveillance system are derived from the Fels Growth Study for ages 0 to 2 years (8), the National Pre-School Survey for ages 2 to 6 (2), and the National Health Examination Surveys, Cycles II and III, for ages 6 to 18 (9,10).

These reference populations are discussed more fully in the recommendations of the Committee on Nutrition Advisory to CDC, Food and Nutrition Board National Research Council (6). Curves based on these populations and a discussion of these curves will be presented in a future surveillance report.

(2) Hemoglobin and hematocrit: for the CDC surveillance system, values for these measures, below which individuals are considered to be anemic, are adapted from reference values of

the WHO group of Experts on Nutritional Anemias (11) and the Ten-State Nutrition Survey (1).

b) Methods of Comparison

(1) Height (or length) and weight: although height and weight are by far the two most used and most useful body measures, there is considerable lack of agreement on how best they should be expressed, in relation to each other and to chosen reference values.

The CDC surveillance system employs three commonly utilized relationships expressing height or weight. The two which are considered to be most useful are height for age (a measure of shortness-tallness), and weight for height (a measure of thinness-fatness). The third measure, weight for age, although extensively employed in the past, is of limited usefulness. It provides no information beyond that provided by the first two. By itself, it may be misleading in certain cases as it reflects weight, height, and linear growth. Height for age is the ratio of height observed to height expected, for that age and sex. Similarly, weight for age is the ratio of weight observed to weight expected, for that age and sex. Weight for height is the ratio of weight observed to weight expected, for that height and sex. Each of these three indices is employed in the CDC system by comparing observed percentile values in relation to reference percentile values.

For each individual who is weighed, measured, and entered into the surveillance system, "standardized" heights and weights are computed, and are expressed either as percentiles or as percentages of the reference median.

For expressing the data as percentiles, each person's place in the percentile distribution of the reference population is calculated by interpolation, between smoothed curves fitted to the 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles for height for age, weight for height, and weight for age. In evaluating a study population, comparison is made of the percentages of that population which falls between certain percentiles, usually the lower 5 or 10, or the upper 5 or 10, of the reference population. Such comparisons are made for each of the three indices, and may be displayed in either tabular or graphic form.

In reporting data as percentages of the reference median, the observed height or weight, in these three indices, is expressed as the arithmetic percentage of the appropriate reference median height or weight.

Weight for height is an excellent indicator of recent undernutrition, (or of overnutrition and overweight), although it cannot indicate whether a person is appropriately tall or short for his or her age. But it does indicate the appropriateness of the relationship between body mass and body length, which is relatively independent of age. These two characteristics make this measure particularly useful in identifying children who have been exposed to relatively recent undernutrition or overnutrition. In the nutrition surveillance system, individuals whose weight for height is below the 5th percentile of the reference population will be identified as potentially acutely undernourished and those above the 95th percentile as being potentially obese.

Height for age is the best indicator of long-term undernutrition, if it has been of sufficient severity and duration to have caused stunting of growth. In this country where exact ages are usually known and famine is not a problem, it is the most helpful measure in detecting the short stature which may result from chronic undernutrition in children, or their mothers. In the nutrition surveillance system those whose height for age is below the 5th percentile of the reference population will be identified as having been subjected to possible long-term undernutrition. The third measure, weight for age, combines in one figure the relatively precise information provided by height for age, and weight for height, and as previously mentioned, may sometimes by itself be misleading. For example, weight for age figures will not have the same connotation in children with stunted stature, whether they be nutritional dwarfs or genetically short. Their weight for age will necessarily be low if their body mass is normal for their height, while their weight for age will be normal only if they are overweight in relation to their height.

(2) Hemoglobin and hematocrit: with these measurements it is most useful to array the data as percentage distributions at successive 0.5 gm% intervals for hemoglobin and at 1.0% intervals for hematocrit.

These data are also analyzed in this CDC surveillance system by percentages of the population, at various age intervals, below the following specified levels:

	Hemoglobin	Hematocrit
6 through 23 months, both sexes	10.0%	31.0%
2 through 5 years, both sexes	11.0	34.0
6 through 14 years, both sexes	12.0	37.0
15 years and over, males	13.0	40.0
15 years and over, females, non-pregnant	12.0	37.0
15 years and over, females, pregnant	11.0	34.0

The cutoff points used to define groups with potential nutrition problems have been derived from consultation with many individuals and professional groups. It is clear to us that there are differences of opinion among workers in the field and that the clinical implications of these cutoff points are not well known. As new data become available which would dictate a change in the cutoff (referral) values, consideration will be given to modifying the reference values used in the nutrition surveillance system.

Nutrition Surveillance in Louisiana: A Review of the First Year's Experience

Summary

During 1973 and 1974, the Nutrition Section of the Louisiana Health and Social and Rehabilitation Services Administration developed one of the most comprehensive nutrition surveillance programs in the United States. The program is based upon data collected from the State's Early Periodic Screening, Diagnosis, and Treatment (EPSDT) Program which was set up to screen children for the Title XIX (Medicaid) Program. The data on height, weight, age, ethnic group, sex, address, hemoglobin, and/or hematocrit are abstracted from the clinic records by clerks in local health units and sent to the Center for Disease Control through the State Nutrition Section.

The Louisiana program has allowed specific comparisons and contrasts among individual parishes, municipalities, and geographic regions within the State. Considerable differences have been found between these various geographic sub-units which cannot be fully explained by differences in ethnic group composition. These data are proving useful to both State and local public health authorities in pinpointing pockets of nutritional deficiencies, and planning remedial action. While the ability of the State program to provide data on small geographic sub-units is very important, only Statewide data will be reported here because of the limited usefulness of the data on geographic differences to nutritionists outside of the State of Louisiana.

Standard tables have been prepared for the use of both State and local health department personnel regarding the prevalence of low hemoglobin by age and ethnic group, low height for age by ethnic group and sex, low weight for age by ethnic group and sex, and low weight for height by ethnic group and sex. These Louisiana data have been analyzed using Stuart-Meredith reference data. Finally, the Louisiana data have permitted tabulation of the degree of stunting and/or wasting in preschool-age children by ethnic group according to the method proposed by Waterlow (13). These data have highlighted a previously unappreciated nutritional problem, specifically the overweight and potentially obese but stunted child.

Findings

Table 1

Mean and Percent of White Children with Low Hemoglobin
By Age Groups - Louisiana, 1973

	Reporting Period											
	Jan. - June				July - Dec.				Total			
Age Group (Yrs.)	No. Exam.	Mean	No. Low	% Low	No. Exam.	Mean	No. Low	% Low	No. Exam.	Mean	No. Low	% Low
<1	95	12.2	3	3.2	97	12.1	2	2.1	192	12.1	5	2.6
1	107	11.7	7	6.5	146	11.5	22	15.1	253	11.6	29	11.5
2 - 5	576	12.2	59	10.2	640	12.2	82	12.8	1,216	12.2	141	11.6
6 - 9	17	11.6	9	52.9	422	12.7	88	20.9	439	12.7	97	22.1
Total	795	12.1	78	9.8	1,305	12.3	194	14.9	2,292	12.2	272	11.9

Table 2

Mean and Percent of Black Children with Low Hemoglobin
By Age Groups - Louisiana, 1973

	Reporting Period											
	Jan. - June				July - Dec.				Total			
Age Group (Yrs.)	No. Exam.	Mean	No. Low	% Low	No. Exam.	Mean	No. Low	% Low	No. Exam.	Mean	No. Low	% Low
<1	513	11.3	63	12.3	523	11.5	63	12.0	1,036	11.4	126	12.2
1	854	10.9	188	22.0	855	10.9	150	17.5	1,709	10.9	338	19.8
2 - 5	3,952	11.7	897	22.7	3,567	11.8	691	19.4	7,519	11.7	1,588	21.1
6 - 9	143	11.8	70	49.0	1,985	12.1	773	38.9	2,128	12.1	843	39.6
Total	5,462	11.5	1,218	22.3	6,930	11.7	1,677	24.2	12,392	11.6	2,895	23.4

Tables 1 and 2 indicate the percent of children screened with low hemoglobin values, by age and ethnic group. These tables show considerably lower proportions of low hemoglobins in white than in black children. Since all children were eligible for Medicaid, it is doubtful that socio-economic status alone explains these differences. Perhaps dietary differences between the two ethnic groups may be responsible for this difference. The increasing prevalence of low hemoglobin with age, and particularly the large increase in the 6-9 year age group over the 2-5 year age group may represent a dietary problem, but may also reflect the inadequacies of the currently accepted norms for hemoglobin in the various age groups.

Table 3

Percentage Distribution of Height for Age by Percentiles by Ethnic Group
For Boys Under Nine Years of Age - Louisiana Surveillance, 19[illegible]

Ht. for Age Percentile	White				Black				Total			
	Jan. - June		July - Dec.		Jan. - June		July - Dec.		Jan. - June		July - Dec.	
	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%
< 5th	22.8	22.8	25.1	25.1	16.6	16.6	15.9	15.9	17.5	17.5	17.4	17.4
5th - 9th	10.6	33.4	8.4	33.5	7.5	24.1	6.4	22.3	7.9	25.4	6.7	24.1
10th - 14th	6.0	39.4	5.1	38.6	3.6	27.7	3.8	26.1	3.9	29.3	4.0	28.1
> 14th	60.7	100.0	61.3	100.0	72.4	100.0	73.9	100.0	70.6	100.0	71.9	100.0
No. Measured	521		726		3,280		3,798		3,80[illegible]		4,524	

Table 4

Percentage Distribution of Height for Age by Percentiles by Ethnic Group
For Girls Under Nine Years of Age - Louisiana Surveillance, 1973

Ht. for Age Percentile	White				Black				Total			
	Jan. - June		July - Dec.		Jan. - June		July - Dec.		Jan. - June		July - Dec.	
	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%
< 5th	18.1	18.1	21.5	21.5	11.8	11.8	11.7	11.7	12.6	12.6	13.2	13.2
5th - 9th	9.0	27.1	12.1	33.6	7.3	19.1	5.9	17.6	7.5	20.1	6.8	20.0
10th - 14th	6.5	33.6	5.9	39.5	4.7	23.8	4.6	22.2	5.0	25.1	4.8	24.8
> 14th	66.2	100.0	60.6	100.0	76.2	100.0	77.8	100.0	74.8	100.0	75.1	100.0
No. Measured	509		694		3,306		3,766		3,815		4,460	

Tables 3 and 4 present the percentages of children in the lower height for age percentiles by ethnic group and sex. These data indicate a higher proportion of white than black children being smaller than accepted growth standards, which confirms the finding of several other nutrition surveys that American blacks tend to be slightly taller in the pediatric age group than American whites. At present we have no explanation for the increased number of male children over female children failing to achieve at least the fifth percentile of accepted growth standards. These data are in agreement with data from the other four States in the Nutrition Surveillance Program.

Table 5

Percentage Distribution of Weight for Height by Percentiles by Ethnic Group
For Boys Under Nine Years of Age - Louisiana Surveillance, 1973

Wt. for Ht.	White				Black				Total			
	Jan. - June		July - Dec.		Jan. - June		July - Dec.		Jan. - June		July - Dec.	
Percentile	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%
<5th	2.7	2.7	2.2	2.2	3.7	3.7	3.5	3.5	3.6	3.6	3.3	3.3
5th - 9th	5.0	7.7	3.3	5.5	4.0	7.7	4.8	8.3	4.2	7.8	4.5	7.8
10th - 14th	2.7	10.4	3.6	9.1	3.3	11.0	4.0	12.3	3.2	11.0	3.9	11.7
>14th	89.6	100.0	91.0	100.0	89.0	100.0	87.7	100.0	89.0	100.0	88.3	100.0
No. Measured	519		723		3,267		3,786		3,786		4,509	

Table 6

Percentage Distribution of Weight for Height by Percentiles by Ethnic Group
For Girls Under Nine Years of Age - Louisiana Surveillance, 1973

Wt. for Ht.	White				Black				Total			
	Jan. - June		July - Dec.		Jan. - June		July - Dec.		Jan. - June		July - Dec.	
Percentile	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%
<5th	3.0	3.0	2.3	2.3	3.0	3.0	3.4	3.4	3.0	3.0	3.2	3.2
5th - 9th	4.7	7.7	4.5	6.8	4.9	7.9	7.0	10.4	4.9	7.9	6.6	9.8
10th - 14th	4.5	12.2	4.5	11.3	4.9	12.8	5.5	15.9	4.9	12.8	5.3	15.1
>14th	87.8	100.0	88.6	100.0	87.1	100.0	84.1	100.0	87.3	100.0	84.8	100.0
No. Measured	507		690		3,296		3,754		3,803		4,444	

Tables 5 and 6 present data on the percent of Louisiana children in the lower percentiles of weight for height by ethnic group and sex. It is generally accepted that weight for height is relatively independent of age, and is a sensitive indicator of acute protein-calorie malnutrition. Despite the fact that large numbers of Medicaid-eligible children in Louisiana fail to attain accepted growth standards as measured by weight for age or height for age, the number of children below accepted standards of weight for height are, if anything, lower than in the reference populations. This indicates that Louisiana children with growth failure are suffering from relatively prolonged exposure to poor nutrition, rather than acute starvation or sufficiently acute calorie deficit to create a wasted or starvation-type of malnutrition.

Table 7

Percentage Distribution of Weight for Age by Percentiles by Ethnic Group
For Boys Under Nine Years of Age - Louisiana Surveillance, 1973

Wt. for Age Percentile	White				Black				Total			
	Jan. - June		July - Dec.		Jan. - June		July - Dec.		Jan. - June		July - Dec.	
	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.
< 5th	9.8	9.8	13.2	13.2	9.3	9.3	10.8	10.8	9.4	9.4	11.2	11.2
5th - 9th	8.3	18.1	10.7	23.9	6.7	16.0	7.6	18.4	6.9	16.3	8.1	19.3
10th - 14th	4.4	22.5	6.2	30.1	4.2	20.2	5.2	23.6	4.2	20.5	5.4	24.7
> 14th	77.5	100.0	69.7	100.0	80.0	100.0	76.3	100.0	79.5	100.0	75.4	100.0
No. Measured	521		726		3,280		3,798		3,801		4,524	

Table 8

Percentage Distribution of Weight for Age by Percentiles by Ethnic Group
For Girls Under Nine Years of Age - Louisiana Surveillance, 1973

Wt. for Age Percentile	White				Black				Total			
	Jan. - June		July - Dec.		Jan. - June		July - Dec.		Jan. - June		July - Dec.	
	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%	%	Cuml.%
< 5th	12.2	12.2	15.4	15.4	8.7	8.7	10.1	10.1	9.1	9.1	10.9	10.9
5th - 9th	10.6	22.8	11.7	27.1	9.4	18.1	9.1	19.2	9.6	18.7	9.5	20.4
10th - 14th	5.9	28.7	6.2	33.3	5.5	23.6	5.7	24.9	5.5	24.2	5.8	26.2
> 14th	71.4	100.0	66.8	100.0	76.4	100.0	75.1	100.0	75.8	100.0	73.8	100.0
No. Measured	509		694		3,308		3,766		3,815		4,460	

Tables 7 and 8 present data on the low weight for age percentiles of Louisiana children by ethnic group and sex. These data indicate that black children have somewhat less growth deficit as measured by weight than do whites, so that they are both taller and heavier for their age than are similar whites. However, these data also reconfirm that there are significant numbers of both black and white lower socio-economic children in Louisiana who are failing to meet accepted growth standards. A large percentage of this excess of short and light children is probably due to an inadequate diet.

Table 9

Classification According to Degrees of Undernutrition and Retardation
Percentage Distribution of White Children 1 Thru 5 Years of Age
Louisiana Surveillance Data - 1973

Weight for Height Grade	% Std.	Height for Age Grade 0 (% Std. > 95) No.	%	1 (95-90) No.	%	2 (90-85) No.	%	3 (< 85) No.	%	Total No.	%
0	> 120	66	3.7	14	0.8	9	0.5	28	1.6	117	6.6
	120-90	1,040	58.8	356	20.1	55	3.1	15	0.8	1,466	82.9
1	90-80	112	6.3	42	2.4	10	0.6	1	0.1	165	9.3
2	80-70	12	0.7	3	0.2	1	0.1	0	0.0	16	0.9
3	< 70	3	0.2	2	0.1	0	0.0	0	0.0	5	0.3
Total		1,233	69.7	417	23.6	75	4.2	44	2.5	1,769	100.0

Table 10

Classification According to Degrees of Undernutrition and Retardation
Percentage Distribution of Black Children 1 Thru 5 Years of Age
Louisiana Surveillance Data - 1973

Weight for Height Grade	% Std.	Height for Age Grade 0 (% Std. >95) No.	%	1 (95-90) No.	%	2 (90-85) No.	%	3 (<85) No.	%	Total No.	%
0	>120	245	2.3	73	0.7	49	0.5	145	1.3	512	4.8
	120-90	7,252	67.6	1,146	10.7	166	1.6	57	0.5	8,621	80.4
1	90-80	1,130	10.5	224	2.1	48	0.5	20	0.2	1,422	13.3
2	80-70	114	1.1	13	0.1	6	0.1	3	0.0	136	1.3
3	<70	32	0.3	2	0.0	0	0.0	0	0.0	34	0.3
Total		8,773	81.8	1,458	13.6	269	2.5	225	2.1	10,725	100.0

Tables 9 and 10 express the anthropometric data on some 10,000 Louisiana children in the preschool-age group in a grid according to the manner of Waterlow. This concept was developed by Seone and Lathem (12) and Waterlow (13), for combining height for age and weight for height data as a cross-tabulation, to delineate clearly the distribution in a population of the several forms of chronic and acute malnutrition whether undernutrition or overnutrition. This table gives the distribution of children in various substandard height for age categories (stunted) by these in various weight for height categories (underweight) or in the category over 120 percent of standard (overweight). This type of presentation has been particularly useful in famine, and in situations of gross undernutrition in developing countries, where large numbers of children are found to be both stunted and wasted. For this reason, large numbers appear in the cells in the lower right hand corner of the grid. To our knowledge these data from Louisiana represent the first time in which overweight children have been included in such a Waterlow type grid. The data indicate that nearly one-third of Louisiana children who can be considered overweight by the criterion of being greater than 120 percent of normal weight for height, are also abnormally small in that they are less than 90 percent of accepted height for age. Of the total number of children, only about 6 percent are less than 90 percent height for age. This indicates the claim that most overweight and probably obese children are getting sufficient nutrition to enable them to meet accepted growth standards is not necessarily valid. Considerable numbers of children in the lower socio-economic white and black population of Louisiana are receiving sufficient calories to enable them to be overweight, and yet have sufficiently poor overall nutrition so that they do not grow as well as they should The Nutrition Section is planning to do further studies to determine the nature of the nutritional defects in these children.

Conclusions

The conclusions which can be drawn from these simple comparisons of height, weight, age, and hemoglobin in Louisiana children with reference standards and data from reference populations, have profound implications. The State Nutrition Section is planning to use these data to plan intervention programs, and bring appreciation of marginal nutritional defects to the attention of the families of affected children, and to the medical care authorities controlling the clinical aspects of the Medicaid program.

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